

Notice of Allowability

Application No.

10/769,239

Examiner

Craig A. Renner

Applicant(s)

ZHANG ET AL.

Art Unit

2627

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to paper(s) filed 07 August 2007.
2. ☒ The allowed claim(s) is/are 1,2,4-14,16,17 and 19-39 (renumbered 1-36, respectively).
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|--|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____ |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____ |

1. Claim 1 is generic and allowable over the prior art of record. Accordingly, the restriction requirement, as set forth in the Office action mailed on 16 October 2006, has been reconsidered in view of the allowability of claims to the elected invention pursuant to MPEP § 821.04(a). **The restriction requirement is hereby withdrawn as to any claim that requires all the limitations of an allowable generic claim.** Claims 14-26, directed to one or more non-elected inventions/species, are no longer withdrawn from consideration because these claims require all the limitations of an allowable generic claim. However, claims 40-55, directed to one or more non-elected inventions/species, remain withdrawn from consideration because they do not require all the limitations of an allowable generic claim.

In view of the above noted withdrawal of the restriction requirement, applicant is advised that if any claim presented in a continuation or divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

Once a restriction requirement is withdrawn, the provisions of 35 U.S.C. 121 are no longer applicable. See *In re Ziegler*, 443 F.2d 1211, 1215, 170 USPQ 129, 131-32 (CCPA 1971). See also MPEP § 804.01.

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided

by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Jonathan E. Prejean on 05 October 2007.

3. The application has been amended as follows:

IN THE SPECIFICATION:

Paragraph [0024] has been amended to read as follows:

[0024] In certain embodiments, the MR sensor 20 is selected from a group consisting of a giant magnetoresistive (GMR) sensor, an anisotropic magnetoresistive (AMR) sensor, a tunneling magnetoresistive (TMR) sensor, a spin-dependent-tunneling (SDT) sensor, a spin valve (SV) sensor, a current-in-plane (CIP) sensor, and a current-perpendicular-to-the-plane (CPP) sensor. In embodiments in which the MR sensor 20 comprises a patterned GMR stack, as schematically illustrated by Figure 1A, the MR sensor 20 comprises a dielectric layer 22 (e.g., aluminum oxide) formed on a substrate 23 (e.g., silicon), a pinning layer 24 over the dielectric layer 22, a pinned layer 25 over the pinning layer 24 and antiferromagnetically coupled to the pinning layer 24 ~~by a nonmagnetic coupling layer (not shown)~~, a spacer layer 26 over the pinned layer 25, a free layer 28 over the spacer layer 26, and an overlayer 29. The GMR-stack structure of the MR sensor 20 of Figure 1A is exemplary; other types and structures of MR sensors 20 are compatible with embodiments described herein.

IN THE CLAIMS:

The claim listing has been amended to read as follows:

1. (Currently Amended) A magnetoresistive read head comprising:
a magnetoresistive sensor stack; and
a bias structure adjacent to the magnetoresistive sensor stack, the bias structure providing a magnetostatic bias field for the magnetoresistive sensor stack, the bias structure comprising:
an underlayer;
a bias layer over the underlayer; and
at least one dusting layer directly below at least one of the underlayer or the bias layer and between the bias layer and the magnetoresistive sensor stack, the dusting layer comprising discontinuous, nano-sized islands.
2. (Original) The magnetoresistive read head of Claim 1, wherein the dusting layer is directly below the underlayer.
3. (Cancelled).
4. (Previously Presented) The magnetoresistive read head of Claim 1, wherein the dusting layer comprises a material having a sufficiently high surface energy and sufficiently low atomic mobility to form the islands.

5. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer is formed by ion-beam deposition.

6. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer comprises a material having a body-centered-cubic crystallographic structure or a CsCl-type crystallographic structure.

7. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer comprises a material selected from a group consisting of tungsten, tantalum, niobium, rhodium, molybdenum, tungsten-titanium alloy, tungsten-chromium alloy, and nickel-aluminum alloy.

8. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer comprises platinum or titanium.

9. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer comprises a material having a melting temperature above a melting temperature of the underlayer.

10. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer comprises a material having a melting temperature above 1800 degrees Celsius.

11. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer has a thickness less than approximately 10 Angstroms.

12. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer has a thickness in a range from approximately 2 Angstroms to approximately 6 Angstroms.

13. (Original) The magnetoresistive read head of Claim 2, wherein the dusting layer has a thickness of approximately 3 Angstroms.

14. (Original) The magnetoresistive read head of Claim 1, wherein the dusting layer is directly below the bias layer.

15. (Cancelled).

16. (Currently Amended) The magnetoresistive read head of Claim 14 [[15]], wherein the dusting layer comprises a material having a sufficiently high surface energy and sufficiently low atomic mobility to form the islands.

17. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer is formed by ion-beam deposition.

18. (Cancelled).

19. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer comprises a material having a body-centered-cubic crystallographic structure or a CsCl-type crystallographic structure.

20. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer comprises a material selected from a group consisting of tungsten, tantalum, niobium, rhodium, molybdenum, tungsten-containing alloy, chromium-containing alloy, tungsten-titanium alloy, tungsten-chromium alloy, and nickel-aluminum alloy.

21. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer comprises a material having a melting temperature above a melting temperature of the underlayer.

22. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer comprises a material having a melting temperature above 1800 degrees Celsius.

23. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer has a thickness less than approximately 10 Angstroms.

24. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer has a thickness in a range from approximately 5 Angstroms to approximately 10 Angstroms.

25. (Original) The magnetoresistive read head of Claim 14, wherein the dusting layer has a thickness of approximately 7 Angstroms.

26. (Original) The magnetoresistive read head of Claim 1, wherein the at least one dusting layer comprises a first dusting layer directly below the underlayer and a second dusting layer directly below the bias layer.

27. (Currently Amended) The magnetoresistive read head of Claim 1, wherein the magnetoresistive sensor stack is selected from a group consisting of a giant magnetoresistive (GMR) sensor, an anisotropic magnetoresistive (AMR) sensor, a tunneling magnetoresistive (TMR) sensor, a spin-dependent-tunneling (SDT) sensor, a

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spin valve (SV) sensor, a current-in-plane (CIP) sensor, and a current-perpendicular-to-the-plane (CPP) sensor.

28. (Currently Amended) The magnetoresistive read head of Claim 1, wherein the magnetoresistive sensor stack is located over an aluminum oxide layer on a silicon substrate.

29. (Original) The magnetoresistive read head of Claim 1, wherein the underlayer comprises a material selected from a group consisting of chromium, chromium-containing alloy, tungsten, tungsten-containing alloy, nickel-aluminum alloy, and iron-aluminum alloy.

30. (Currently Amended) The magnetoresistive read head of Claim 29, wherein the underlayer comprises a chromium-containing alloy and the chromium-containing alloy comprises a material selected from a group consisting of titanium, vanadium, molybdenum, ~~maganese~~ manganese, and tungsten.

31. (Previously Presented) The magnetoresistive read head of Claim 29, wherein the underlayer comprises a tungsten-containing alloy and the tungsten-containing alloy comprises a material selected from a group consisting of chromium, titanium, vanadium, and molybdenum.

32. (Original) The magnetoresistive read head of Claim 1, wherein the underlayer has a thickness in a range from approximately 20 Angstroms to approximately 250 Angstroms.

33. (Original) The magnetoresistive read head of Claim 1, wherein the underlayer has a thickness in a range from approximately 70 Angstroms to approximately 200 Angstroms.

34. (Previously Presented) The magnetoresistive read head of Claim 1, wherein the bias layer comprises a material selected from a group consisting of CoPt, CoCrPt, CoCrPtTa, CoCrPtB, CrPt, and FePt.

35. (Original) The magnetoresistive read head of Claim 1, wherein the bias layer has a thickness in a range from approximately 75 Angstroms to approximately 300 Angstroms.

36. (Original) The magnetoresistive read head of Claim 1, wherein the bias layer has a thickness in a range from approximately 100 Angstroms to approximately 250 Angstroms.

37. (Original) The magnetoresistive read head of Claim 1, further comprising an electrically conductive lead layer over the bias layer.

38. (Original) The magnetoresistive read head of Claim 37, wherein the lead layer comprises a material selected from a group consisting of gold, tungsten, rhodium, chromium, and copper.

39. (Original) The magnetoresistive read head of Claim 37, wherein the lead layer has a thickness in a range from approximately 100 Angstroms to approximately 1000 Angstroms.

40-55. (Cancelled).

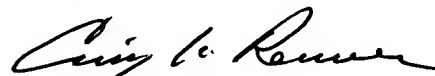
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4. The drawings were received on 31 January 2004. These drawings are accepted.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Craig A. Renner whose telephone number is (571) 272-7580. The examiner can normally be reached on Tuesday-Friday 9:00 AM - 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, A. L. Wellington can be reached on (571) 272-4483. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Craig A. Renner
Primary Examiner
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